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THE ASIATIC BEETLE, A SERIOUS PEST IN LAWNS[1]

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INTRODUCTION

In the summer of 1920 specimens of a scarabaeid beetle were collected at New Haven, Conn. (*1*).[3] This insect, which was later determined to be the Asiatic beetle, *Anomala orientalis* Waterhouse, increased rapidly in numbers, and serious injury to lawns was soon reported. Outside of Connecticut, the Asiatic beetle is now found in five counties in southeastern New York (*4*) and in the northern part of New Jersey, and serious turf injury has occurred in these localities.

The cane fields on the island of Oahu, Territory of Hawaii, were threatened with destruction by the Asiatic-beetle grubs until control was effected by the introduction of a wasp, *Scolia manilae* Ashmead, from the Philippine Islands. The Asiatic beetle had been described from Japan before its introduction into Hawaii and the United States.

When the Bureau of Entomology of the United States Department of Agriculture began research work on this beetle in 1927, a careful study of the life history of the Asiatic beetle was necessary in order that effective control measures might be developed. These include both the working out of practical measures of artificial control and the importation of parasites from the native home of the beetle.

FOOD PLANTS OF THE ADULT ASIATIC BEETLE IN THE UNITED STATES

In the United States, at the latitude of infestation near New York City, the adult Asiatic beetle feeds very little. Here the beetles are more active and feed a little more readily on very hot days, but even on the hottest days this feeding is never sufficiently extensive to cause alarm. They feed sparingly on grass blades, oftener on flowers; and although the damage to these is nearly negligible, the petals and the center of the blossom are more or less injured. Light-colored flowers are eaten most, and roses, hollyhocks, phlox, dahlias, and Japanese iris are preferred, in the order given.

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[1] Contribution No. 61 of the Japanese Beetle Laboratory, Moorestown, N. J.

[2] The writer expresses his gratitude to L. B. Smith, principal entomologist in charge of the Japanese beetle laboratory, for his direction in the work, and his assistance in the preparation of this circular.

[3] Italic numbers in parentheses refer to "Literature cited," p. 6.

ECONOMIC INJURY BY THE LARVÆ

The Asiatic beetle is a grassland insect, spending about 10 months of the year as a larva or grub in turf, mainly in lawns, where it has been found in numbers ranging up to 550 to the square foot. The grub usually feeds close to the surface of the soil on the roots of living plants, especially of lawn grasses. Though this feeding frequently kills the grass in June, it is much more extensive in August and September, and in the latter month large areas in lawns turn brown and die.

Infestation is not uniform over any large area, and rarely over an entire lawn (*2*). The places where the turf has been killed range in size from a few square inches to three or four acres. Spots of severe infestation may be a few yards apart, or, in some cases, several miles apart.

The total area of turf injured in New York State in 1928 was approximately 15 acres of lawn at widely separated points on Long Island and the lawns on about 12 blocks in Westchester County cities. During 1929 the area in the eastern part of the United States known to be infested with the Asiatic beetle suffered from a drought unusually severe for this section of the country. The lawns in this area were burned brown, and large patches on these lawns were permanently injured. Many eggs and young larvæ of the Asiatic beetle died during the dry summer. As a result of these weather conditions of 1929 only about 5 per cent as much injury to lawns by the grub of this beetle was apparent in that year as during the preceding year.

The damage on the estate of the late Elbert Gary at Jericho on Long Island illustrates the destructiveness of this insect. Here 5,000 pounds of lead arsenate was used to secure grub-proof turf on approximately 3½ acres of lawn during the years 1926, 1927, and 1928, and there still remained about 2 acres of untreated lawn where the turf was ruined. The infested area at New Haven, Conn., covered about 1 square mile (*3, p. 587*).

The larvæ prefer unshaded lawns where the grass is kept short by frequent mowing. They also appear to avoid plants that have coarse roots when grasses with fine, fibrous roots are abundant.

DESCRIPTION AND LIFE HISTORY OF THE INSECT

The adult Asiatic beetle varies in color, ranging from entirely straw-colored to entirely black, but is typically straw-colored with dark markings. (Fig. 1.) The thorax may be entirely black except for the straw-colored margins, or a light median line may divide the thorax into two black areas. The wing covers are usually straw-colored, with one or two U-shaped bands and a black spot at the inner basal angle of each. The ventral surface of the insect is either light or dark, corresponding to the predominating color of the dorsal surface.

The insect ranges in length from five-sixteenths to seven-sixteenths inch, and in width from three-sixteenths to one-fourth inch.

At the latitude of New York City the Asiatic beetle generally completes its life cycle in one year, although there are some individuals that pass two winters as larvæ. The adults begin to emerge about June 23 to 25 and are present until about August 25. A considerable part of the adult life is spent in the ground. Most flying takes place between 8 a. m. and 4 p. m. The flight is rather swift and short, usually but a few feet, although occasionally individuals have been observed to rise to a height of from 8 to 15 feet and to fly several hundred yards. On a few hot days, about the middle of July, adults have been observed swarming like bees over lawns. The flights were then short, and only about 1 foot above the ground. When flying to a food plant the beetles generally alight on or near a blossom and soon bury themselves among the petals.

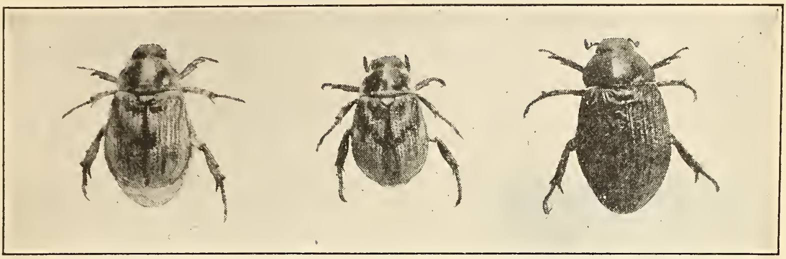

Figure 1.—Adults of the Asiatic beetle, *Anomala orientalis*, showing variation in size, color, and markings. × 2

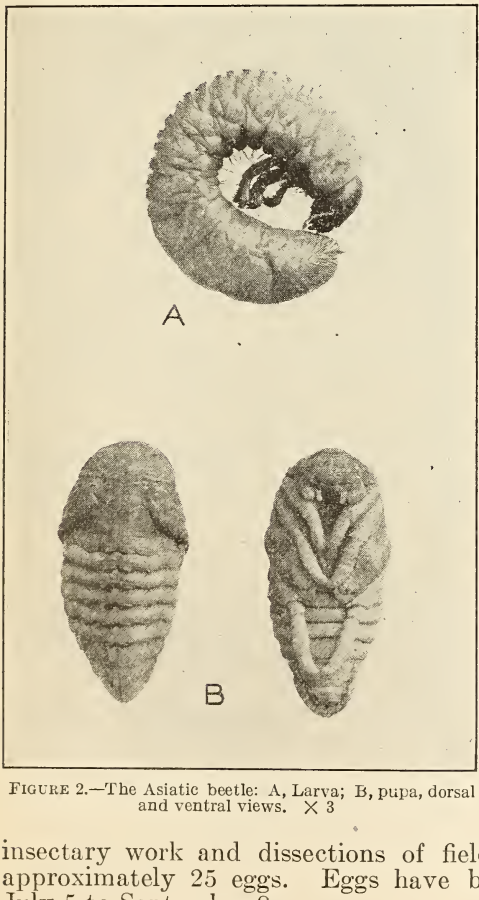

Figure 2.—The Asiatic beetle: A, Larva; B, pupa, dorsal and ventral views. × 3

The females burrow into the soil to oviposit. On Long Island the white eggs, about 1 millimeter in diameter, are deposited singly from 1 to 9 inches beneath the surface, though most of them are found within 5 inches of the top. Under insectary conditions a single female has been known to deposit 63 eggs. The probable average, judged by insectary work and dissections of field-collected female beetles, is approximately 25 eggs. Eggs have been found in the field from July 5 to September 8.

After hatching, the young larvæ, which are about one-sixteenth inch long, burrow upward to near the surface of the soil, where they feed on tender young grass roots and decaying vegetable matter. They molt twice before they become fully grown, at which time they are approximately 1 inch long. They resemble white grubs, or May beetle larvæ, both in general appearance and in possessing two longitudinal rows of pointed spines on the underside of the last segment. (Fig. 2, A; fig. 3.) However, they are smaller than full-grown white grubs and have a transverse anal opening, whereas this is V or Y shaped in the white grubs.

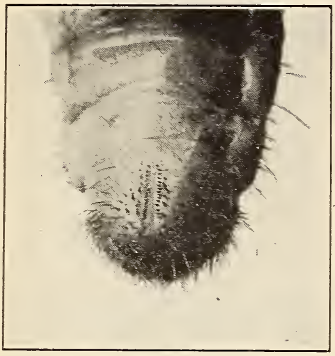

FIGURE 3.—The Asiatic beetle. Ventral view of pygidium showing distinguishing hairs. × 5

Most of the feeding is done in the top layer of soil. The grass roots are cut off about half an inch below the surface, and as a result large patches of detached dead turf can be lifted. When the weather is warm and the grubs are active a considerable number can often be found feeding at a depth of from 4 to 8 inches. Feeding continues until freezing. About October 10 a downward migration of the larvæ begins. The larvæ descend to a depth of from 8 to 17 inches, where they pass the winter. A few individuals hibernate in the first instar, about 40 per cent in the second, and the remainder in the third instar.

About the latter part of April they return to the surface and feed on grass roots until early in June. Each larva then prepares a cell. This cell, which is a little larger than the insect, is found on the average approximately 5 inches below the surface, and is formed by packing the soil. The larva becomes a prepupa in the cell, all feeding ceases, the legs lose their function and become shriveled, and the color changes to a yellowish white. This condition lasts about seven days, after which the insect enters the pupal stage.

The pupa (fig. 2, B), which lies in the cast skin of the third-instar larva, remains in the cell from 10 to 15 days. Pupæ have been found in the field from June 3 to August 19. The adult emerges by splitting the pupal shell, but it remains in the cell for a few days until the new shell has hardened.

DISPERSION

The natural spread of the Asiatic beetle has been slow because it very rarely indulges in long flights. When the infestation becomes very heavy there is an outward dispersion.

Mechanical agencies are of considerable importance in the spread of this insect. Large numbers of adults are often completely hidden in rose blossoms and could easily be carried in them long distances. The greatest danger, however, lies in the shipment of plants with a ball of earth, sod, or soil that might contain larvæ.

CONTROL

INSECT PARASITES

The remarkable success which was obtained by introducing the Scolia wasp, *Scolia manilae* Ashmead, into Hawaii for the control of the Asiatic beetle indicates the importance of parasite enemies. In 1922 this wasp was introduced from Hawaii into New Jersey in large numbers, but extensive experimental work by L. B. Smith showed that the insect could not withstand the rigors of that climate.

Experimental work has shown that some of the natural enemies of the Japanese beetle, *Popillia japonica* Newman, are also enemies of the closely related Asiatic beetle. Small colonies of three of these natural enemies have been released in the locality infested by the Asiatic beetle on Long Island. It is still too early to predict what success may be expected from the introduction of these parasites.

In June and July, 1927, a black wasp, *Tiphia vernalis* Rohwer, which had been collected at Suigen, Chosen (Korea), by T. R. Gardner of the Bureau of Entomology, was released near Jericho on Long Island, N. Y. During the season 267 adult female wasps and 500 parasitized Asiatic-beetle grubs were placed in the field at the Jericho infestation of the Asiatic beetle, which is one of the largest infestations on Long Island. About one week after the wasps had been released Asiatic-beetle larvæ bearing eggs, apparently of this parasite, were collected in the field.

In August, 1927, another wasp, *Tiphia popilliavora* Rohwer, a natural parasite of Japanese-beetle grubs, which is now established near Riverton, N. J., was found to attack the larvæ of the Asiatic beetle readily. One hundred and twenty-five adult females of this wasp were collected in New Jersey and shipped to Long Island. From this shipment 110 wasps, along with 266 Asiatic-beetle grubs which had been parasitized by these wasps under insectary conditions, were placed in the infested territory near Jericho. In the summer of 1928 this colony was further strengthened by releasing 200 adult female wasps.

A dexiid parasite, *Dexia ventralis* Aldrich, was found attacking the grubs of several closely related scarabaeid beetles in Chosen in 1922. Nine hundred adults of this species were released in 1927 near Jericho, where grubs of the Asiatic beetle were numerous.

ARTIFICIAL CONTROL

Carbon-disulphide emulsion has been used extensively on lawns infested with grubs (*5, 9*). During the spring and fall of 1926, in New Haven, Conn., Johnson (*5, p. 375*) treated 43.5 acres of lawns infested with Asiatic-beetle grubs with carbon-disulphide emulsion which contained 70 per cent of carbon disulphide and was diluted 200 times with water. Three pints of the diluted liquid were applied to each square foot of the surface. This treatment gave 98 per cent kill, but the relief was only temporary and the following season the lawns became reinfested. Later experiments showed that lawn turf could be rendered grub proof by the application of lead arsenate to the soil. This treatment may be applied at any time between April 1 and October 30.

The best method of rendering lawns grub proof is the following, which was developed by Leach (*6, 7, 8*): 5 pounds of lead arsenate thoroughly mixed with 1 bushel of screened, moist (not wet) sand or good topsoil is to be used as a top-dressing, distributed evenly over 1,000 square feet of lawn surface. The area of the lawn (exclusive of that portion of the lot occupied by buildings and gardens) should be calculated accurately to insure sufficient application for a control. Let us suppose that our measurements show that we have an average lawn of 3,000 square feet to be top-dressed. For this area we should use 15 pounds of lead arsenate and 3 bushels of screened soil. In order to secure a thorough mixing the soil should be spread in a thin layer on a hard (preferably concrete) floor and the lead arsenate spread on top of the soil. The soil and lead arsenate should be turned over several times with a shovel until the lead arsenate has become so thoroughly mixed with the soil that the entire heap has become an even color. There is some labor connected with this method but it has been found necessary for two reasons: (1) Lead arsenate is a light powder and a large loss will result from a direct application due to blowing away, and (2) it is a very difficult matter to apply 5 pounds of lead arsenate evenly to 1,000 square feet.

The poisoned soil may now be applied to the lawn, and the application should be made only when the grass is dry. The lawn should be divided off into six or eight even parts and the heap of poisoned soil also should be divided equally into the same number of parts. This will aid the worker in distributing by hand the poisoned soil over the lawn. The lawn should be raked over so that the top-dressing works down through the grass without sticking, the slight possibility of temporary burning of the grass being thus avoided.

When large lawns are to be treated, it is well to mix 25 pounds of lead arsenate with 1 cubic yard of top-dressing and to apply the mixture to 5,000 square feet of turf either by hand or by means of a lime spreader. It is advisable to repeat the top-dressing three years in succession, as this will build up a layer of poisoned soil which should be effective for a further period of three or four years. It is the poison in the first inch that effects control.

Caution: Lead arsenate should not be applied to lawns or golf courses where stock are allowed to feed.

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